

# **Army Fire Support Investment Framework**

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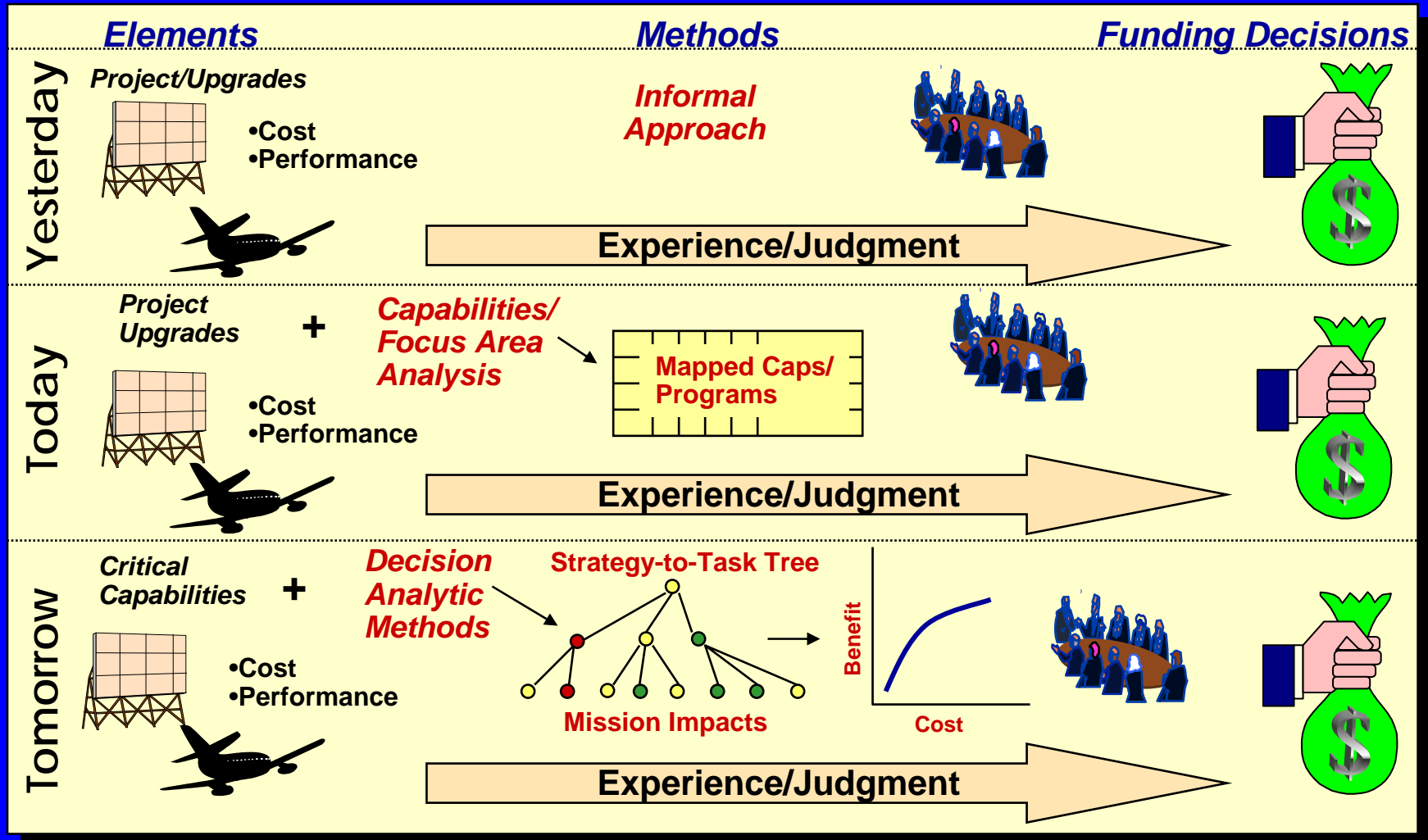
# Goal of the Analysis

**Develop a framework to support System-of-Systems investment decisions using the Army Fire Support Battlefield Operating System as a pilot**

**Concept: *Apply a capability-based analysis approach***

# Background

## *Move Towards A Capability-Driven Investment Decision Making*



# **DoD Guidance for Capability-Based Investment Analysis & Data Sources for Fire Support Mission Breakout**

- **Guidance: CJCSI 3170.01C requires implementation of a capabilities-based methodology to support development of integrated architectures.**
  - **“The methodology must provide end-to-end traceability of DOTML-PF solutions through the capabilities supported for each Joint Functional Concept.”**
- **TRADOC Pamphlet 525-3-9, Future Force Fire and Effects Concept of Operation, September 2003.**
- **FM6-20-10 Targeting Doctrine**
- **Army Precision Engagement (PE) Architecture**
  - **Part of Capabilities-Based Objective Force Architecture developed by Army Architecture Integration Cell**

# Key Tool: The Portfolio AnaLysis Machine (PALMA)

- PALMA is a decision support tool developed by MITRE that facilitates **Capability-Based** investment planning
- Supports an investment strategy *process*
- Brings together:
  - The investment options
  - Their cost
  - What they do for you (detailed impacts)
  - How that fits into your overall goals (mission performance from detailed impacts)
- Finds the best portfolio of investments based on cost and mission-level benefit

# Steps in Applying a Portfolio Analysis Approach

- **Build the mission capability “strategy-to-task” tree hierarchy**
- **Develop “roll-up” performance combination rules from functions to lower-level tasks**
- **Make baseline performance assessments for lowest level tasks**
- **Identify investment options and map their impact to specific tasks in the capability tree**
- **Apply decision analytic methodologies/tools**
- **Gain insights to make investment recommendations**

# PALMA “Tree” Page

**PALM - NotionalPGM7**

File Options Page Options

Data Tree Graph Preprocess Impact

RESULTS

Cost = 4

Benefit = 39

Levels: -1 +1

View: Top Up 1 level Subtree

☒ Battlefield Geo  
☒ Weather  
☒ Mapping Sys  
☐ ThreatAnalysis v1  
☐ ThreatAnalysis v2  
☐ ATD Breakout  
☐ Imaging System  
☐ Image Annot  
☐ Mensur Pts  
☐ Folder Gen v1  
☐ Folder Gen v2  
☐ Msn Plan Sys  
☐ Weaponer Sys  
☐ AircraftSup v1  
☐ AircraftSup v2

**Investment Options**

**Capability Tree**

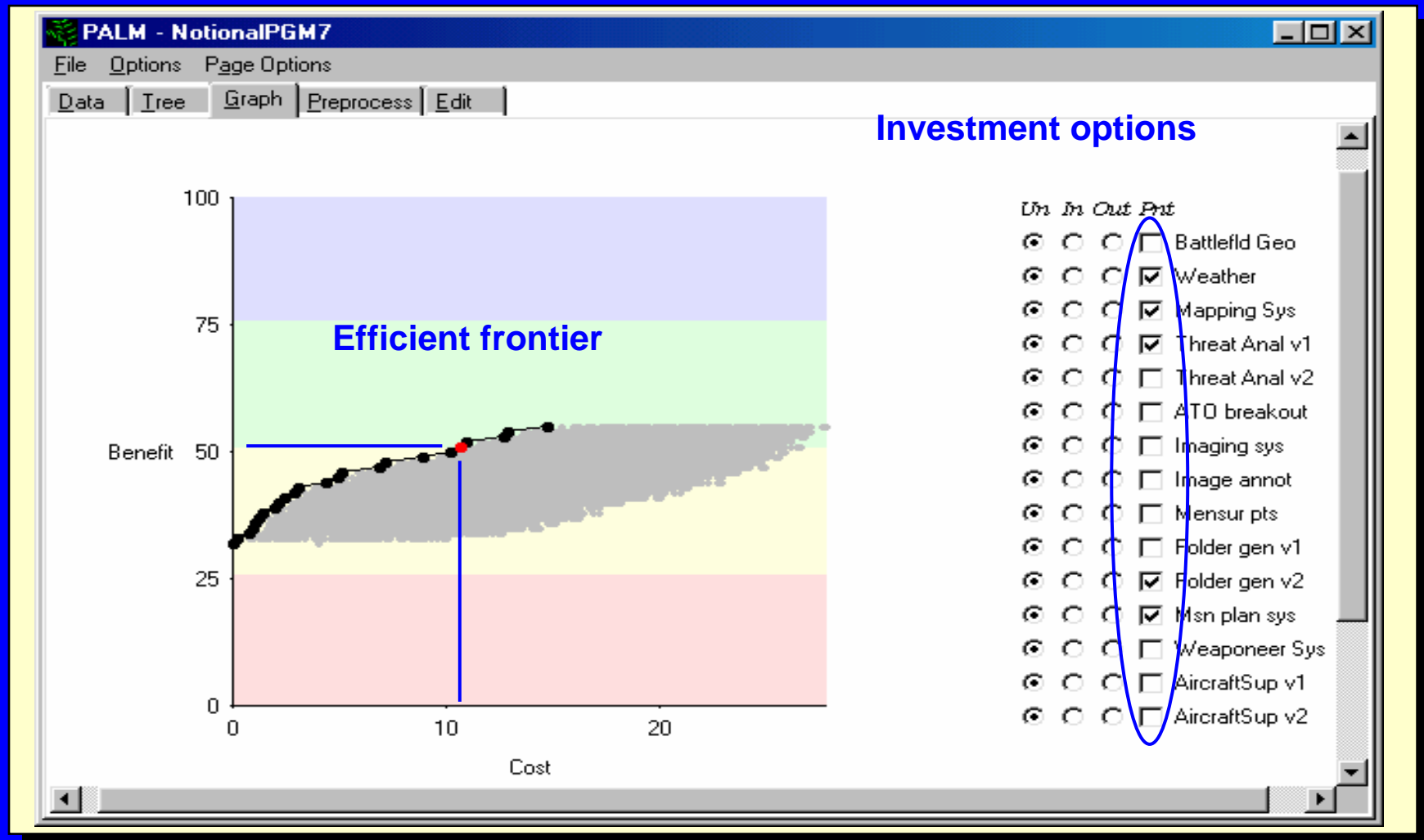
PGM planning capability

- Wing/unit level C2
  - ATO rec
  - ATO bre
  - Aircraft/schedul
  - Weather ✓
  - Update databa
  - Update databa
  - ATO bre
- Intel and targeting
  - ATO bre
  - Threat ar
  - Aircrew m briefings/re
  - Battle dat assessment, reporti
  - ATO bre ✓
- Mission planning
  - Route pla
  - Weather ✓
  - Publish m materi
  - Aircraft
  - Munitions prep
- Support
  - ATO breakout
  - Plot targets
  - Target resear
  - ATO breakout
  - Plot targets ✓
  - Route planning
  - Plot targets ✓
  - Threat analys
  - Calculate laur areas
  - PGM flyout
  - GPS info
  - Publish missi
  - Data transfer device

Target research prep  
 DMPI identification  
 DMPI identification prep  
 Weaponer  
 Target folder generation  
 PGM flyout prep  
 Sensor/sensor model ✓  
 Mensuration points



# PALMA “Graph” Page



PALMA - Army FDA-G8\_010604\_No\_groups\_colors\_w\_documentation



# Plan and Control Fires Subtree

**PALMA - Army FDA-G8\_010604\_No\_groups\_colors\_w\_documentation**

File Legal Write Mode Adjust Navigate Genetic

Data Tree Graph Preprocess Impact

Node 1.11

ISO Lt forces: AFATDS Effect

abbrev = ISOLtforAF  
color = red  
color# = 17  
rule = \*  
return = 0.1250

Affected by options:  
\*19 AFATDS

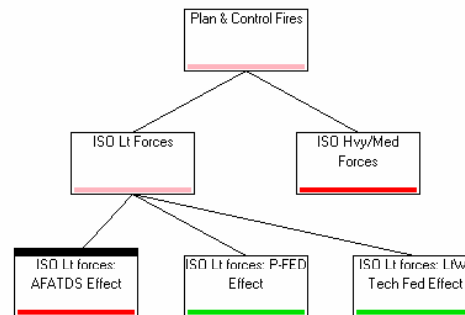
green (83)

B=55, C=2000

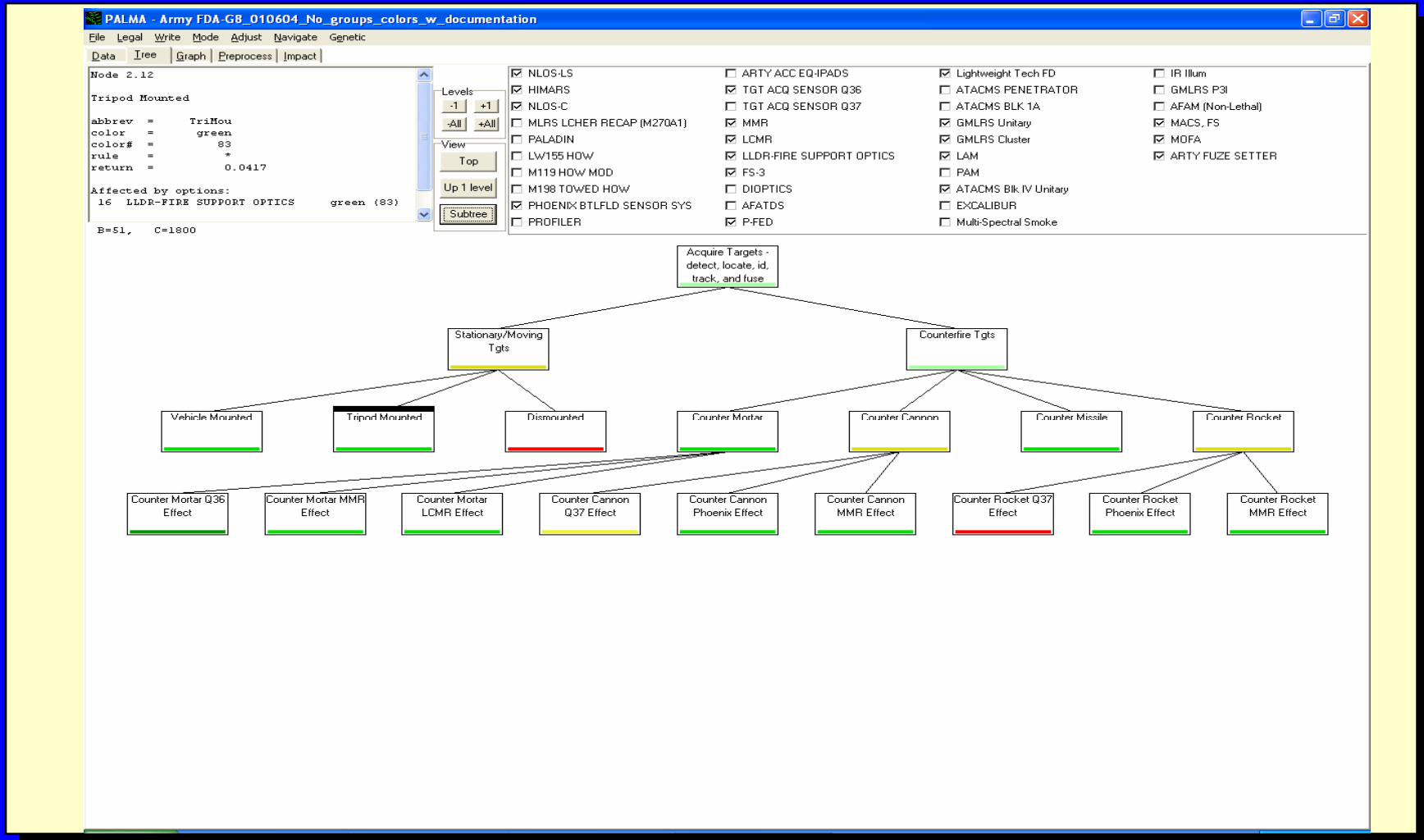
Levels: -1 +1 -All +All

View: Top Up 1 level Subtree

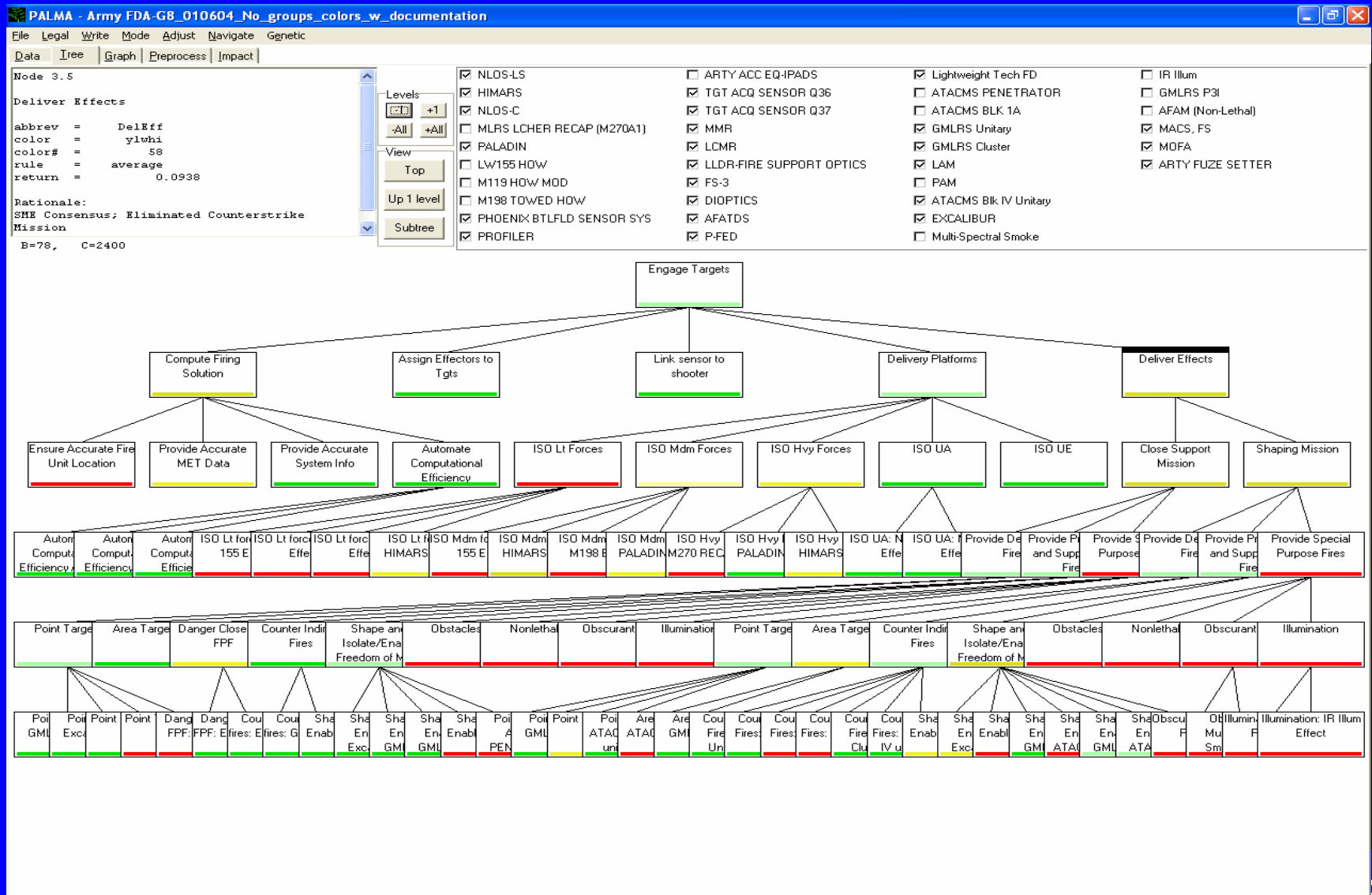
<input checked="" type="checkbox"/> NLOS-LS	<input type="checkbox"/> ARTY ACC EQ-IPADS	<input checked="" type="checkbox"/> Lightweight Tech FD	<input type="checkbox"/> IR Illum
<input checked="" type="checkbox"/> HIMARS	<input checked="" type="checkbox"/> TGT ACQ SENSOR Q36	<input type="checkbox"/> ATACMS PENETRATOR	<input type="checkbox"/> GMLRS P3I
<input checked="" type="checkbox"/> NLOS-C	<input checked="" type="checkbox"/> TGT ACQ SENSOR Q37	<input type="checkbox"/> ATACMS BLK 1A	<input type="checkbox"/> AFAM (Non-Lethal)
<input type="checkbox"/> MLRS LCHER RECAP (M270A1)	<input checked="" type="checkbox"/> MMR	<input checked="" type="checkbox"/> GMLRS Unitary	<input checked="" type="checkbox"/> MACS, FS
<input type="checkbox"/> PALADIN	<input checked="" type="checkbox"/> LCMR	<input checked="" type="checkbox"/> GMLRS Cluster	<input checked="" type="checkbox"/> MOFA
<input type="checkbox"/> LW155 HOW	<input checked="" type="checkbox"/> LLDR-FIRE SUPPORT OPTICS	<input checked="" type="checkbox"/> LAM	<input checked="" type="checkbox"/> ARTY FUZE SETTER
<input type="checkbox"/> M119 HOW MOD	<input checked="" type="checkbox"/> FS-3	<input type="checkbox"/> PAM	
<input type="checkbox"/> M198 TOWED HOW	<input checked="" type="checkbox"/> DIOPTICS	<input checked="" type="checkbox"/> ATACMS Blk IV Unitary	
<input checked="" type="checkbox"/> PHOENIX BTLFLD SENSOR SYS	<input type="checkbox"/> AFATDS	<input type="checkbox"/> EXCALIBUR	
<input type="checkbox"/> PROFILER	<input checked="" type="checkbox"/> P-FED	<input type="checkbox"/> Multi-Spectral Smoke	



# Acquire Targets Subtree



# Engage Targets Subtree



# Engage Targets/Compute Firing Solution Breakout

**PALMA - Army FDA-G8\_010604\_No\_groups\_colors\_w\_documentation**

File Legal Write Mode Adjust Navigate Genetic

Data Tree Graph Preprocess Impact

Node 3.1

Compute Firing Solution

abbrev = ComFirSol  
color = ylwhi  
color# = 63  
rule = wgh\_aver[1,1,1,2]  
return = 0.0938

Rationale:  
SME Consensus

B=78, C=2400

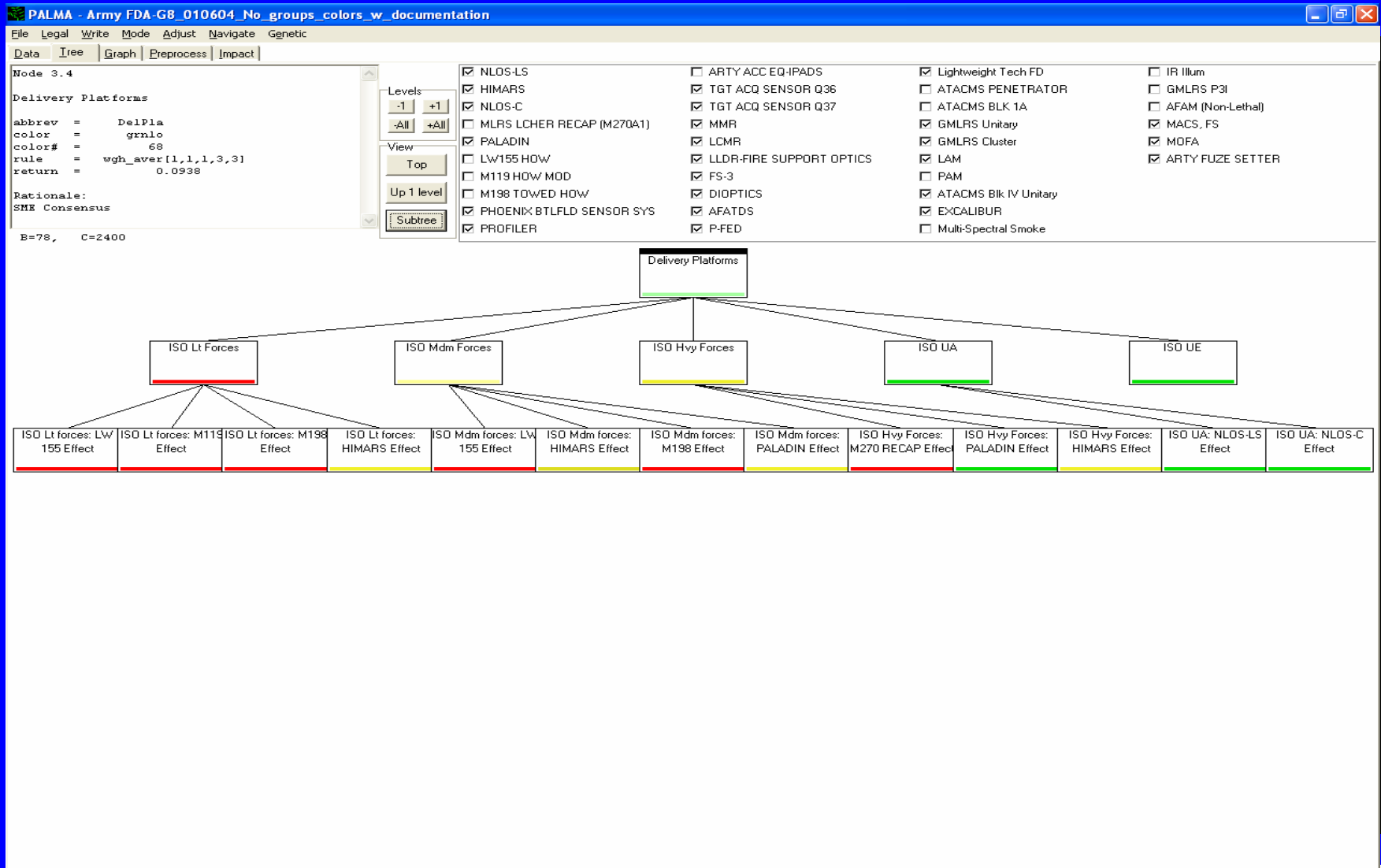
Levels: -1 +1 -All +All

View: Top Up 1 level Subtree

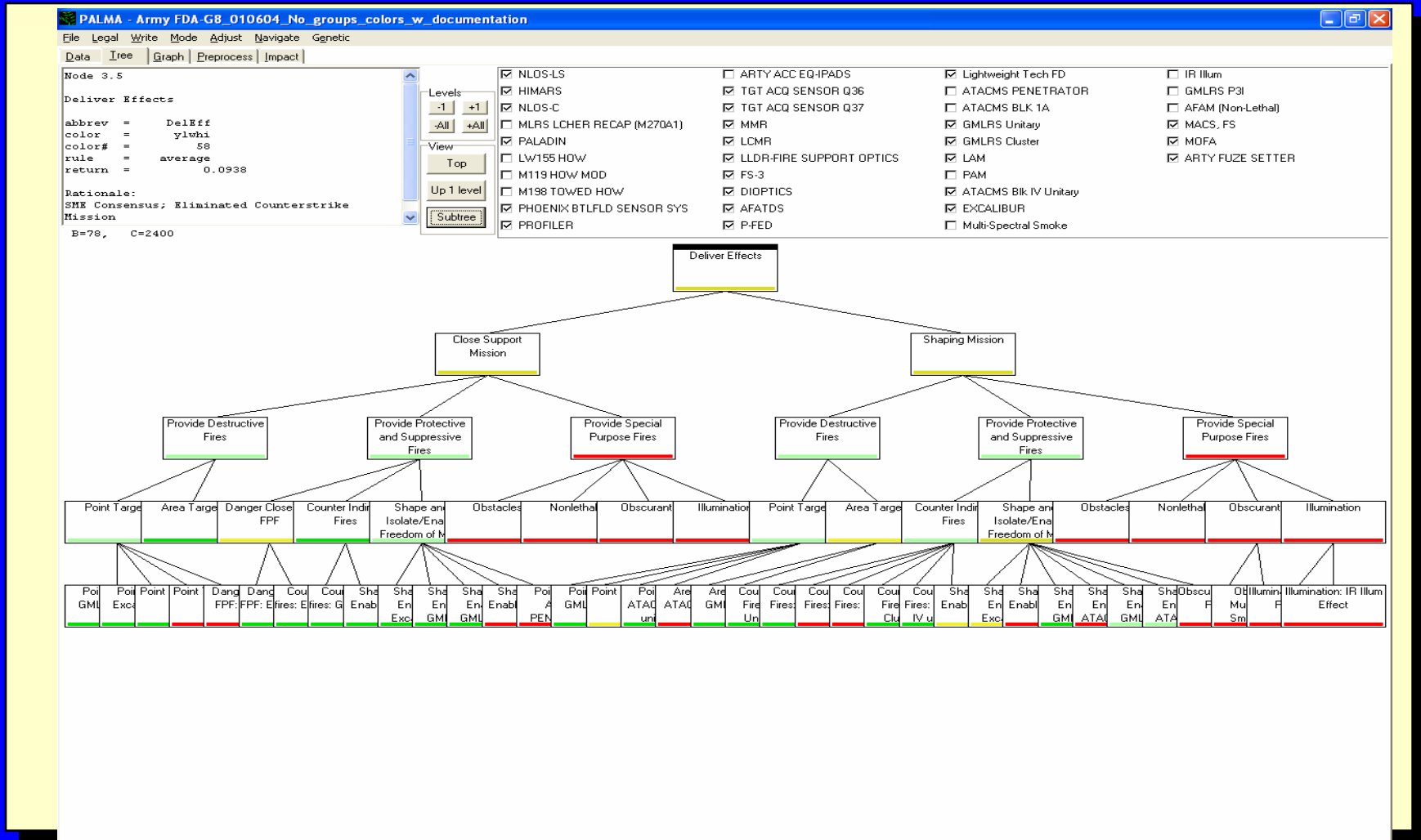
<input checked="" type="checkbox"/> NLOS-LS	<input type="checkbox"/> ARTY ACC EQ-IPADS	<input checked="" type="checkbox"/> Lightweight Tech FD	<input type="checkbox"/> IR Illum
<input checked="" type="checkbox"/> HIMARS	<input checked="" type="checkbox"/> TGT ACQ SENSOR Q36	<input type="checkbox"/> ATACMS PENETRATOR	<input type="checkbox"/> GMLRS P31
<input checked="" type="checkbox"/> NLOS-C	<input checked="" type="checkbox"/> TGT ACQ SENSOR Q37	<input type="checkbox"/> ATACMS BLK 1A	<input type="checkbox"/> AFAM (Non-Lethal)
<input type="checkbox"/> MLRS LCHER RECAP (M270A1)	<input checked="" type="checkbox"/> MMR	<input checked="" type="checkbox"/> GMLRS Unitary	<input checked="" type="checkbox"/> MACS, FS
<input checked="" type="checkbox"/> PALADIN	<input checked="" type="checkbox"/> LCMR	<input checked="" type="checkbox"/> GMLRS Cluster	<input checked="" type="checkbox"/> MQFA
<input type="checkbox"/> LW155 HOW	<input checked="" type="checkbox"/> LLDR-FIRE SUPPORT OPTICS	<input checked="" type="checkbox"/> LAM	<input checked="" type="checkbox"/> ARTY FUZE SETTER
<input type="checkbox"/> M119 HOW MOD	<input checked="" type="checkbox"/> FS-3	<input type="checkbox"/> PAM	
<input type="checkbox"/> M198 TOWED HOW	<input checked="" type="checkbox"/> DIOPTICS	<input checked="" type="checkbox"/> ATACMS BLK IV Unitary	
<input checked="" type="checkbox"/> PHOENIX BTLFLD SENSOR SYS	<input checked="" type="checkbox"/> AFATDS	<input checked="" type="checkbox"/> EXCALIBUR	
<input checked="" type="checkbox"/> PROFILER	<input checked="" type="checkbox"/> P-FED	<input type="checkbox"/> Multi-Spectral Smoke	

```
graph TD; A[Compute Firing Solution] --> B[Ensure Accurate Fire Unit Location]; A --> C[Provide Accurate MET Data]; A --> D[Provide Accurate System Info]; A --> E[Automate Computational Efficiency]; E --> F[Automate Computational Efficiency AFATDS]; E --> G[Automate Computational Efficiency P-FED]; E --> H[Automate Computational Efficiency];
```

# Engage Targets/Delivery Platforms Breakout

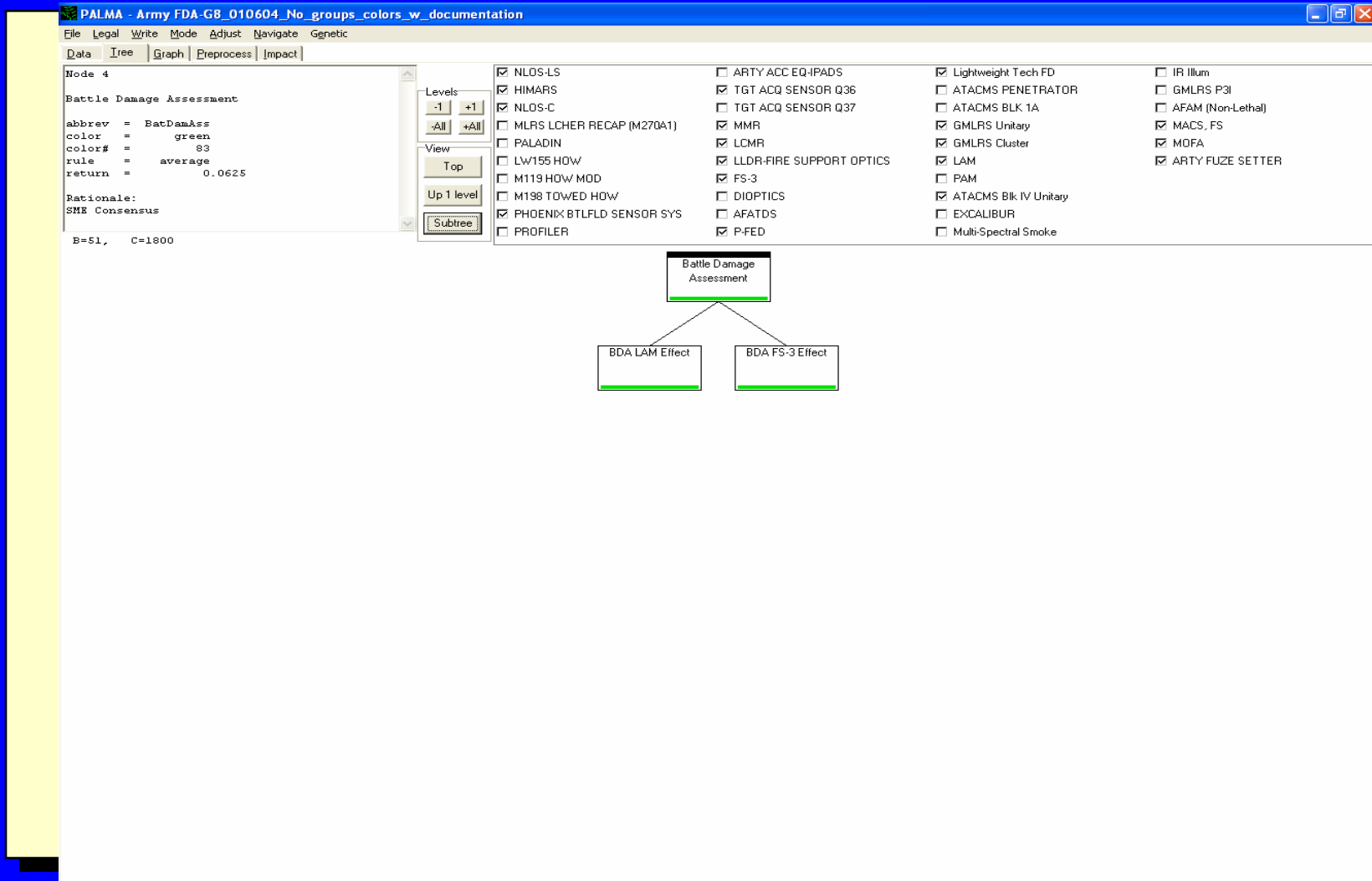


# Engage Targets/Deliver Effects Breakout

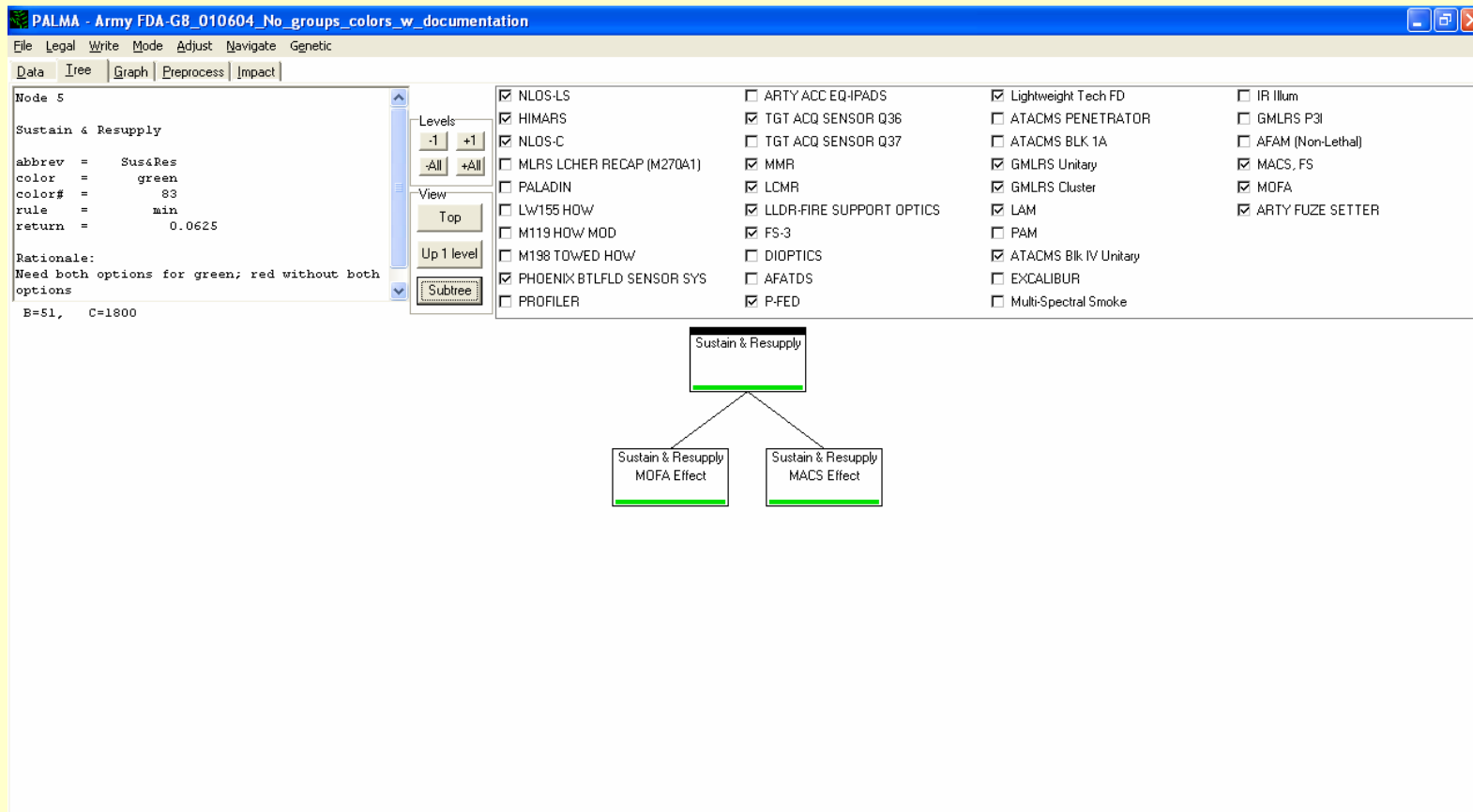




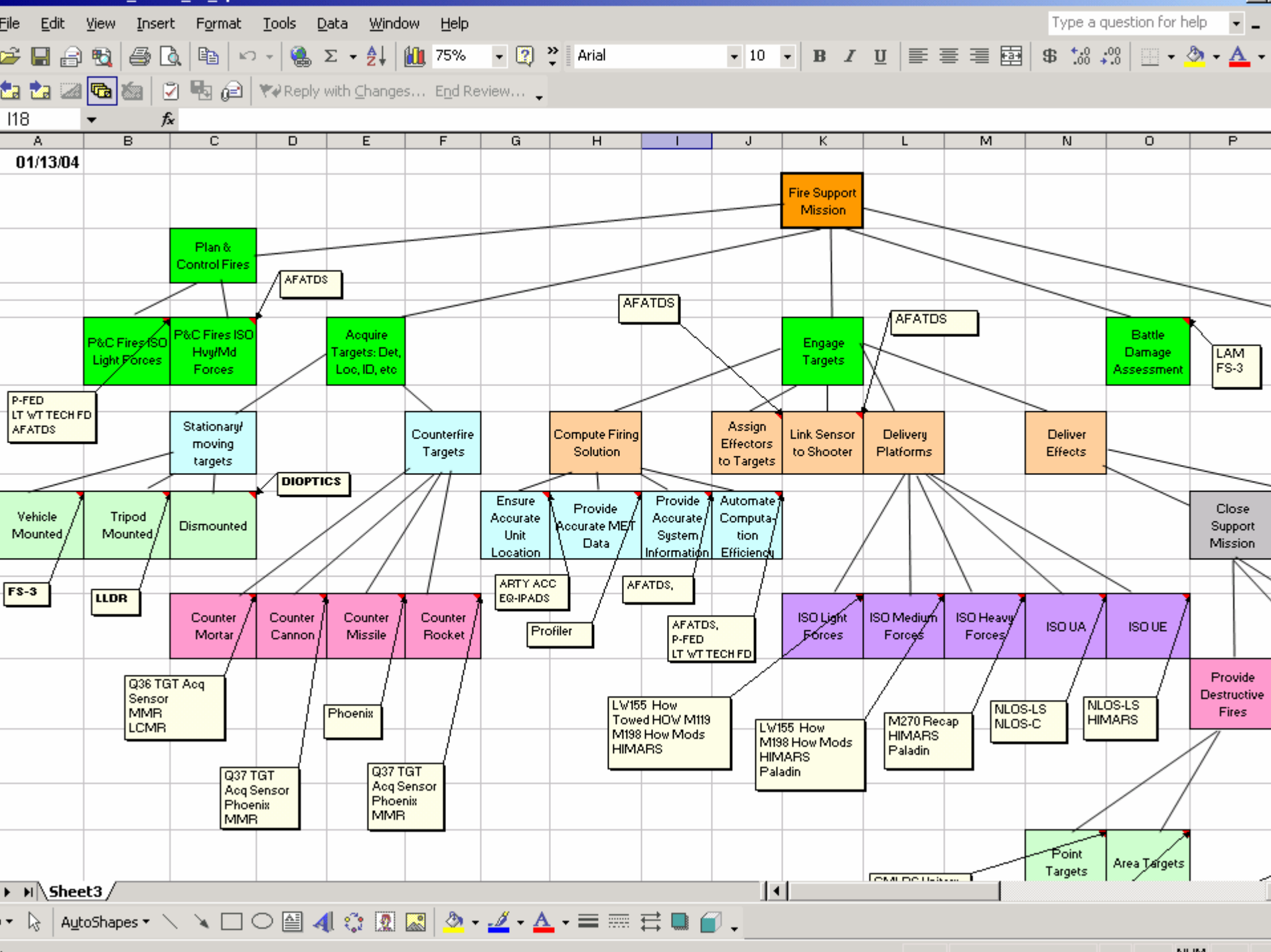
# Battle Damage Assessment Subtree

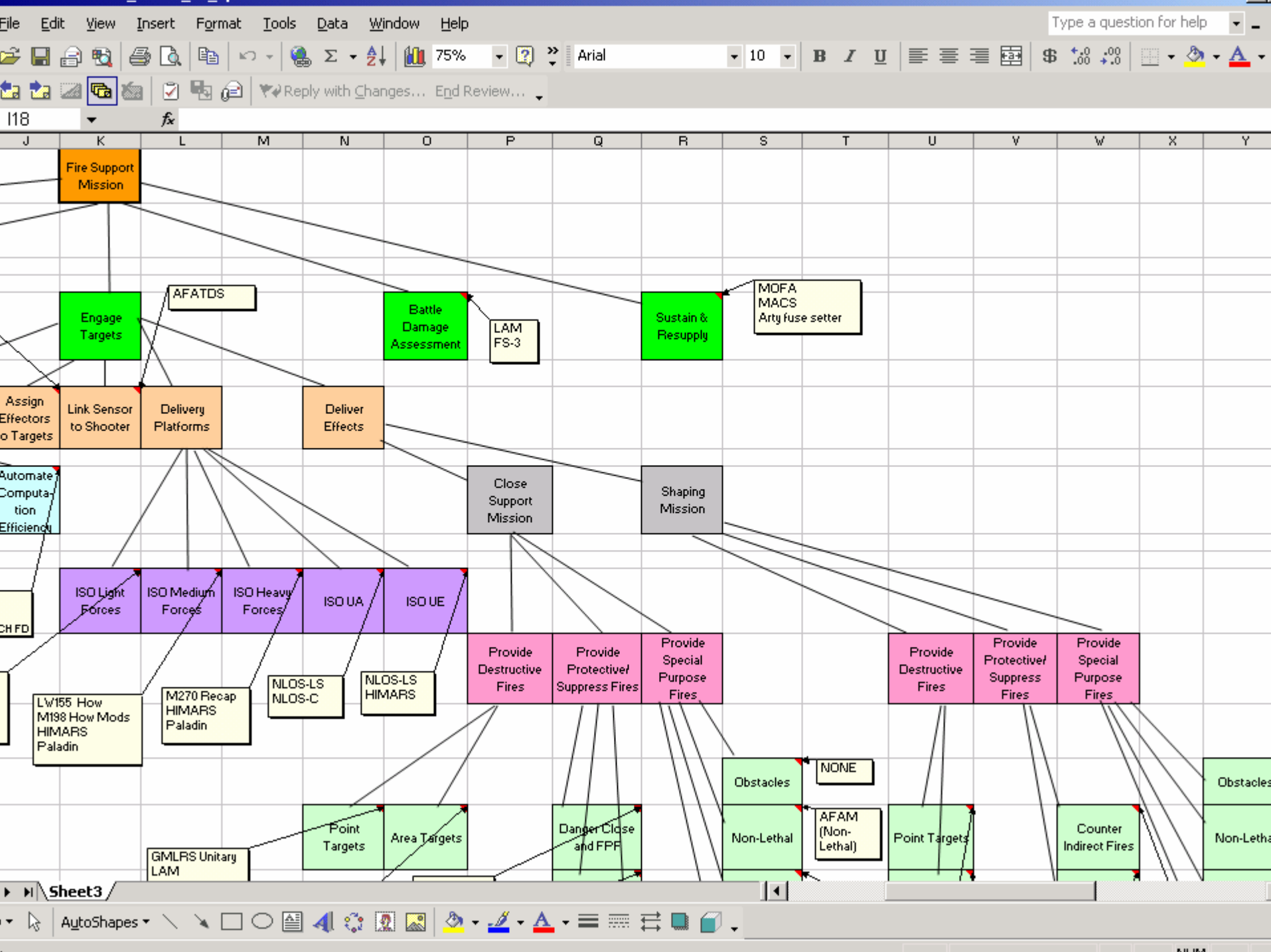


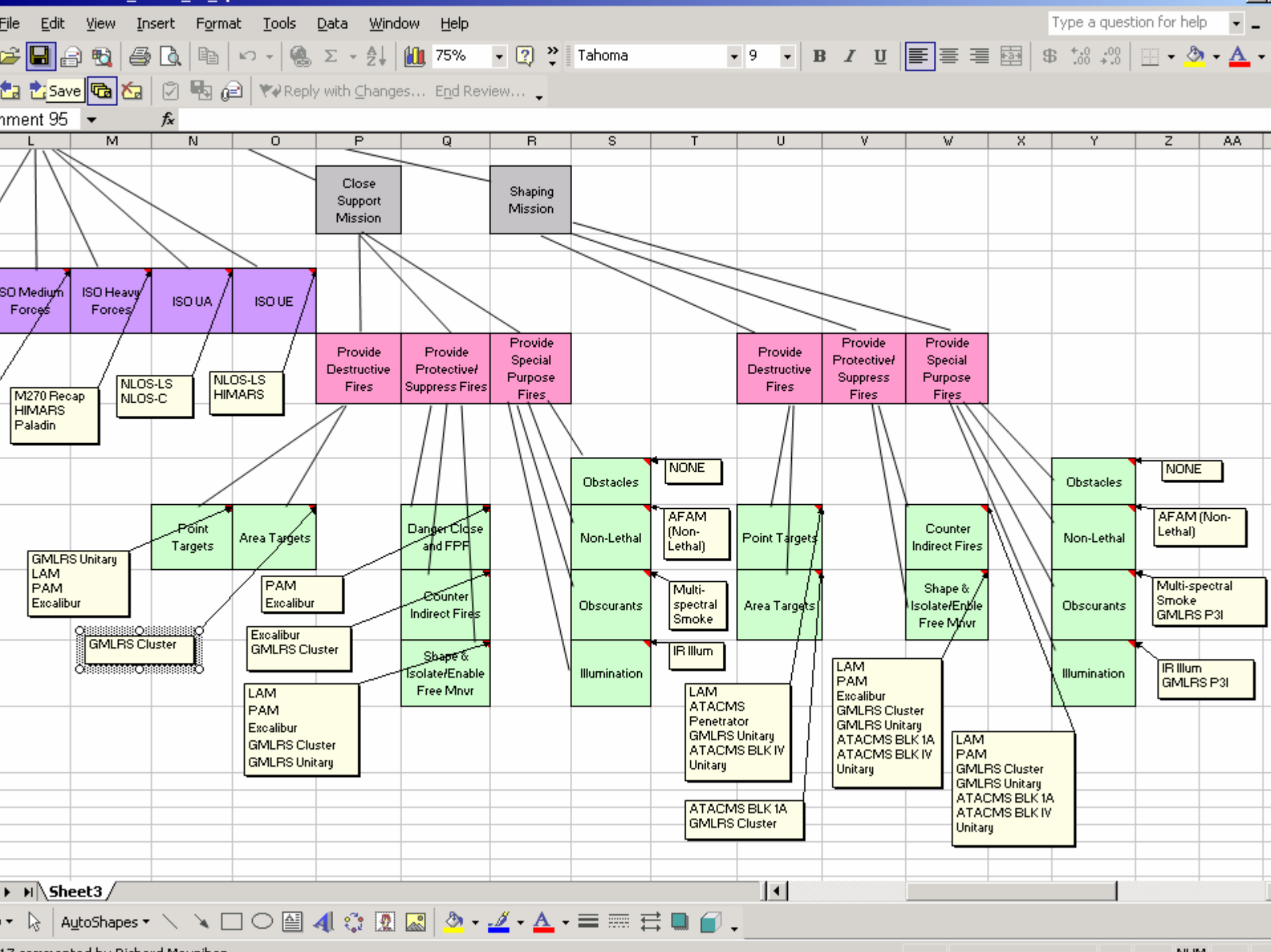
# Sustain and Resupply Subtree



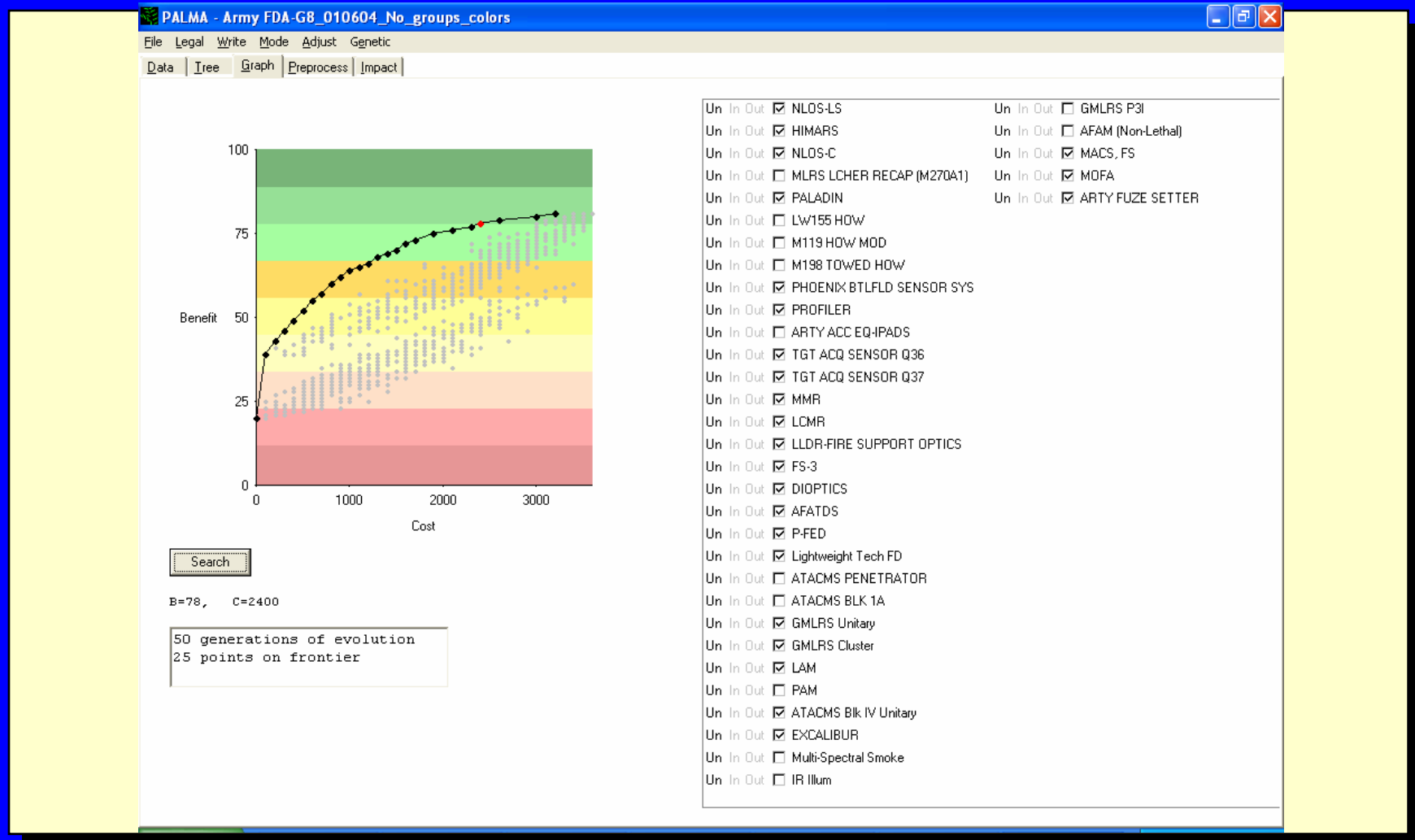
# Matching of Systems to PALMA Leaf Nodes







# Efficient Frontier for Fire Support Mission



# Additional PALMA Functionality

- Multi time period capability
- Accounting for dependencies between investment options (ex: If you procure LAM, you must also procure NLOS-LS)
- Ability to portray levels within a color band (“high yellow”, “low green” etc.)
- Addition of new roll-up rule functions (lim average)
  - Example: Under “Provide Destructive Fires: Point Targets” can represent SME judgment that “I’m Red unless I have both GMLRS Unitary and ATACMS Block IV Unitary systems, but need ATACMS Penetrator and LAM to reach full (Green) capability”



# Why a Portfolio Analysis Approach?

***With appropriate up-front investment of time and resources, portfolio analysis can be an integral component of effective budget planning and mission thread analysis***

- Forcing-function for detailed assessment/decomposition of mission
  - Provides a structure that pulls in results from other architecture studies and detailed mission analyses
  - Provides an intuitive visual representation of mission
  - Supports dialog across stakeholder groups
- Can be used for quick what-ifs and sensitivity analyses after initial recommendation/assessment developed
- May only need to be “tweaked” to be relevant across years